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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b)

Attorney Docket No. 81862.P176 Total Pages 3

First Named Inventor or Application Identifier Hisham Abdelhamid

Express Mail Label No. EL 234 217 744 US

ADDRESS TO: **Assistant Commissioner for Patents**
Box Patent Application
Washington, D. C. 20231

APPLICATION ELEMENTS
See MPEP chapter 600 concerning utility patent application contents.

1. X Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)

2. X Specification (Total Pages 29)
(preferred arrangement set forth below)
- Descriptive Title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings (if filed)
- Detailed Description
- Claims
- Abstract of the Disclosure

3. X Drawings(s) (35 USC 113) (Total Sheets 8)

4. X Oath or Declaration (Total Pages 5)

a. X Newly Executed (Original or Copy)

b. ___ Copy from a Prior Application (37 CFR 1.63(d))
(for Continuation/Divisional with Box 17 completed) **(Note Box 5 below)**

i. ___ DELETIONS OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

5. ____ Incorporation By Reference (useable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ____ Microfiche Computer Program (Appendix)

7. ____ Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
a. ____ Computer Readable Copy
b. ____ Paper Copy (identical to computer copy)
c. ____ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. __X__ Assignment Papers (cover sheet & documents(s))

9. _____ a. 37 CFR 3.73(b) Statement (where there is an assignee)

__X__ b. Power of Attorney (Executed)

10. _____ English Translation Document (if applicable)

11. _____ a. Information Disclosure Statement (IDS)/PTO-1449

_____ b. Copies of IDS Citations

12. _____ Preliminary Amendment

13. __X__ Return Receipt Postcard (MPEP 503) (Should be specifically itemized)

14. _____ a. Small Entity Statement(s)

_____ b. Statement filed in prior application, Status still proper and desired

15. _____ Certified Copy of Priority Document(s) (if foreign priority is claimed)

16. X Other: Certificate of Express Mailing pursuant to CFR §1.10.

17. **If a CONTINUING APPLICATION,** check appropriate box and supply the requisite information:

___ Continuation ____ Divisional ____ Continuation-in-part (CIP)

of prior application No:_____

18. **Correspondence Address**

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or

__X__ Correspondence Address Below

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FEE TRANSMITTAL FOR FY 2000

TOTAL AMOUNT OF PAYMENT ($) $1,306.00

Complete if Known:

Application No.	Not Yet Assigned
Filing Date	July 31, 2000 (concurrently herewith)
First Named Inventor	Hisham Abdelhamid
Group Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket No.	81862.P176

METHOD OF PAYMENT (check one)

1. [X] **The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:**

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   [X] **Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17**

2. X **Payment Enclosed:**
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FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	690	201	345	Utility application filing fee	690.00
106	310	206	155	Design application filing fee	
107	480	207	240	Plant filing fee	
108	690	208	345	Reissue filing fee	
114	150	214	75	Provisional application filing fee	

SUBTOTAL (1) $ 690.00

2. EXTRA CLAIM FEES

			Extra Claims		Fee from below		Fee Paid
Total Claims	39	– 20** =	19	X	18.00	=	342.00
Independent Claims	6	– 3** =	3	X	78.00	=	234.00
Multiple Dependent						=	

****Or number previously paid, if greater; For Reissues, see below.**

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	78	202	39	Independent claims in excess of 3
104	260	204	130	Multiple dependent claim, if not paid
109	78	209	39	**Reissue independent claims over original patent
110	18	210	9	**Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) $ 576.00

Patent fees are subject to annual revisions. Small Entity payments must be supported by a small entity statement, otherwise large entity fees must be paid.
See Forms PTO/SB/09-12

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for response within first month	
116	380	216	190	Extension for response within second month	
117	870	217	435	Extension for response within third month	
118	1,360	218	680	Extension for response within fourth month	
128	1,850	228	925	Extension for response within fifth month	
119	300	219	150	Notice of Appeal	
120	300	220	150	Filing a brief in support of an appeal	
121	260	221	130	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive unavoidably abandoned application	
141	1,210	241	605	Petition to revive unintentionally abandoned application	
142	1,210	242	605	Utility issue fee (or reissue)	
143	430	243	215	Design issue fee	
144	580	244	290	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	40.00
146	690	246	345	For filing a submission after final rejection (see 37 CFR 1.129(a))	
149	690	249	345	For each additional invention to be examined (see 37 CFR 1.129(a))	

Other fee (specify) _____

Other fee (specify) _____

SUBTOTAL (3) $ 40.00

*Reduced by Basic Filing Fee Paid

SUBMITTED BY:

Typed or Printed Name: Jeffrey S. Smith

Signature _____ Date July 31, 2000

Reg. Number 39,377 Deposit Account User ID _____ (complete if applicable)

Attorney Docket No. 081862.P176 *PATENT*

UNITED STATES PATENT APPLICATION

FOR

SYSTEM AND METHOD FOR IMPROVING RELIABILITY OF A PACKET NETWORK

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SYSTEM AND METHOD FOR IMPROVING RELIABILITY OF A PACKET NETWORK

FIELD OF THE INVENTION

The present invention relates generally to telecommunication systems and, more particularly, to a system and method for improving reliability of a packet network which may carry voice communications.

BACKGROUND OF THE INVENTION

Switching and multiplexing techniques, such as asynchronous transfer mode (ATM) and internet protocol (IP) techniques, are designed for transmitting digital information, such as data, video, and voice, at high speed, with low delay, over a telecommunications network. These networks include a number of switching nodes coupled through communication links.

In these networks, bandwidth capacity is allocated to fixed-sized units named "cells." The communication links transport the cells from a switching node to another. These communication links can support many virtual connections, also named channels, between the switching nodes. The virtual connections, for example a Virtual Channel Connection (VCC) or a Permanent Virtual Circuit (PVC), assure the flow and delivery of information contained in the cells.

The ATM Forum, which is a user and vendor group establishing ATM standards, has also defined several ATM service categories, used in characterization of a virtual connection. For example, among such service categories are (1) a Constant Bit Rate (CBR), which supports a constant or guaranteed rate to transport services, such as video or voice, as well as circuit emulation, which requires rigorous timing control and performance parameters; (2) a Variable Bit Rate (VBR), real time and non real time, which supports variable bit rate data traffic with average and peak traffic parameters; (3) an Available Bit Rate (ABR), which supports feedback to control the source rate in response to changed characteristics in the network; and (4) an Unspecified Bit Rate (UBR).

Figure 1a illustrates a prior art packet network 100, typically including several network nodes, also known as switching nodes, 110 connected through single communication links 120. The packet network 100 is a data transmission network with guaranteed bandwidth and quality of service. Typically, end users 130 access the network 100 and connect to the nodes 110 via similar links 120. Generally, the illustrated communication links 120 carry traffic from many sources to many destinations and may support multiple virtual connections. Although these virtual connections may be statistically multiplexed onto the same link, the network 100 must still meet certain quality of service requirements for each connection.

A failure within the network 100 will interrupt the flow of data from a source end user to a destination end user. When the flow of data is interrupted for a longer period of time, typically for a period longer than 500 milliseconds, some voice communications, such as voice calls, carried by the network will be dropped. In order to improve the reliability of networks, several systems have been designed to eliminate such extended data interruptions.

One such system is an automatic protection switching (APS) system. As illustrated in **Figure 1b**, in the packet network 100, parallel links 122, 124 connect the nodes 110 and are used to transmit duplicate information between the nodes 110 and to ensure fast and reliable data transmission. Link 122 is called an "active" link, while link 124 is a "stand-by" link. Because the same information is transmitted on both links 122, 124, the switching node 110 located at the receiving end can choose either link to receive the transmitted information. For example, if the active link 122 fails, the stand-by link 124 can deliver the same information to the switching node. This APS configuration can be implemented, for example, with the SONET/SDH standards, and can also be used to transport data packets instead of voice communications.

Although the APS system addresses link failures and can switch to a redundant link within 250 milliseconds, it cannot solve a node failure, or any other network failure. Also, although the APS system increases the reliability

of packet networks, the duplicated data sent on both links 122, 124 reduces the bandwidth in half, resulting in a waste of bandwidth.

SUMMARY OF THE INVENTION

A system and method for improving reliability of a packet network are described. Data is transmitted on a first virtual circuit in the network. A message signaling a failure in receipt of the data is received on a second virtual circuit in the network. Finally, transmission of data is switched to the second virtual circuit within a predetermined period of time.

Other features and advantages of the present invention will be apparent from the accompanying drawings and from the detailed description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example and not limitation in the figures of the accompanying drawings, in which like references indicate similar elements and in which:

Figure 1a shows an exemplary connection-oriented network.

Figure 1b shows an exemplary connection-oriented network with an example of an Automatic Protection Switching (APS) system.

Figure 2 shows an exemplary packet network for handling voice communications.

Figure 3 shows one embodiment of the system for improving reliability of an Internet Protocol network.

Figure 4 is a flow diagram representing the method for improving reliability of a packet network as applied to a transmitting gateway module.

Figures 5a and **5b** are flow diagrams representing methods for improving reliability of a packet network as applied to a receiving gateway module.

Figure 6 shows an alternate embodiment of the system for improving reliability of an Asynchronous Transfer Mode network.

DETAILED DESCRIPTION

In one embodiment, the following discussion is presented in the context of a Voice over packet network, such as an Internet Protocol (IP) network. However, the present invention is not limited to IP networks and may be implemented with other types of networks, such as Frame Relay networks or Asynchronous Transfer Mode (ATM) networks. At the same time, the discussion refers to the communication paths into the IP network as virtual circuits (VCs). However, the present invention may be implemented with different types of communication paths or virtual circuits, such as Permanent Virtual Circuits (PVCs), Switched Virtual Circuits (SVCs), or a combination of PVCs and SVCs.

Internet Protocol (IP) Network Implementation

Figure 2 shows an exemplary connection-oriented network for handling voice communications, such as voice calls. As shown in **Figure 2**, in one embodiment, an end user 210, trying to initiate a voice call directed to a second end user 250, transmits a sequence of bits along link 215 to a network 200 via a transmitting first gateway module 220. The transmitting gateway module 220 includes a line card 225 connected to the network. In one embodiment, line card 225 is a VISM card, available from Cisco Systems, Inc., of San Jose, California. In one embodiment, the sequence of bits is transmitted at a standard

rate into gateway module 220, is received by the line card 225, and translated into packets.

In one embodiment, the translation procedure also includes a compression procedure, applied to reduce redundancy in the voice packets. In addition, the translation may include a silence suppression algorithm, or Voice Activity Detection (VAD), which suppresses transmission of data during silence intervals. This results in reducing the transmitted bit rate when the user is not communicating.

Referring again to **Figure 2**, the data packets are then sent through the network 230 and reach a receiving second gateway module 240, prior to being delivered to the second user 250. The receiving gateway module 240 also includes a line card 245 connected to the network 200. In one embodiment, line card 225 is a VISM card, available from Cisco Systems, Inc., of San Jose, California. Once received within line card 245 of gateway module 240, the packets are decoded and translated back into a sequence of bits representing voice, which are then transmitted to user 250 along link 255. The system for improving reliability of the network 200 will now be described in further detail.

The same process of transmission, encoding, and decoding may also take place from end user 250 through gateway module 240, network 230, and gateway module 220 to end user 210.

Figure 3 shows one embodiment of the system for improving reliability of an Internet Protocol network. As illustrated in **Figure 3**, line card 225 within gateway module 220 is connected to line card 245 within gateway module 240 through a core of routers 230, 232, 234, 236 provided within network 200. In one embodiment, routers 230, 232, 234, 236 are high-speed routers with ATM interfaces interconnected using communication links 250. In one embodiment, the communication links 250 are Packet over SONET links, having fully redundant APS protection.

Line card 225 is connected to router 230 through a link carrying an ATM virtual circuit 228 and is further connected to router 232 through another link carrying ATM virtual circuit 229. At the same time, line card 245 is connected to router 234 via a link carrying ATM virtual circuit 238 and is further connected to router 236 via a link carrying ATM virtual circuit 239. The ATM virtual circuits 228, 229, 238, 239 can support multiple voice connections between gateway modules 220 and 240. Each virtual circuit 228, 229, 238, 239 is provisioned with a predetermined bandwidth, sufficient to support all connections established by gateway modules 220 and 240. In one embodiment, each virtual circuit uses the entire predetermined bandwidth to accommodate the connections. Alternatively, each virtual circuit may use only a portion of the bandwidth, with the remaining bandwidth being used by other data traffic within the network.

In one embodiment, if a user initiates a voice call through gateway module 220, line card 225 establishes a connection along virtual circuit 228, through routers 230 and 234, along virtual circuit 238 to line card 245 within gateway module 240, and on to a second user. Data packets are transmitted along the established connection to the second user. Alternatively, line card 225 within gateway module 220 may establish a connection along virtual circuit 229, through router 232 and 236 to line card 245 within gateway module 240 or to another gateway module (not shown) and its respective user.

In the event of a network failure along communication links 250, the APS system reroutes the flow of data packets from a failed link onto another redundant link, thereby restoring the connection between the two gateway modules 220 and 240. A method for restoring the connection in the event of a router failure or any other failure within network 200 will be described in further detail below.

In one embodiment, line card 225 within gateway module 220 establishes a connection along virtual circuit 228 and starts transmission of data packets through routers 230 and 234. Line card 245 within gateway module 240 monitors each connection along virtual circuits 238 and 239 and receives data sent from line card 225 along virtual circuit 238. In one embodiment, if a failure is declared in router 230 or router 234 within network 200, the connection which allows the flow of data packets along virtual circuit 238 is affected and

line card 245 stops receiving data. Alternatively, the failure may be declared on the link carrying virtual circuit 228 or the link carrying virtual circuit 238.

Line card 245 within gateway module 240 continues to monitor both virtual circuits 238 and 239, and transmits a type A message along virtual circuits 238 and 239 if data is not received on the established connection for a predetermined period of time. In one embodiment, the predetermined period of time is 50 milliseconds, selected to ensure that line card 245 does not interpret a short interruption in the flow of data packets as a network failure. Alternatively, another time period may be selected with the same results.

Line card 245 within gateway module 240 will not monitor the virtual circuits for a gap in receipt of data packets until a first data packet is received on that particular connection. Line card 245 will wait for the first data packet, then monitor the virtual circuits 238 and 239 for the gap, and transmit the type A message if the gap is greater than the predetermined period of time of 50 milliseconds.

The message travels along virtual circuits 238 and 239 and will eventually reach line card 225 within gateway module 220. In one embodiment, if the failure is declared on either router 230 or 234, or along virtual circuits 228 or 238, the message will be transmitted through routers 236 and 232 and will be received by line card 225 along virtual circuit 229.

Once line card 225 within gateway module 220 receives the message, it switches transmission of data from virtual circuit 228 to virtual circuit 229. Data packets will now be transmitted along virtual circuit 229, through routers 232 and 236, and along virtual circuit 239. In one embodiment, line card 225 switches virtual circuits on an individual connection-by-connection basis. Since the failure may be declared anywhere within network 200, other connections within virtual circuit 228 may not be affected and will not be switched to a different virtual circuit.

Line card 225 within gateway module 220 must complete the switchover and resume transmission of data along virtual circuit 229 within a predetermined period of time, in order to ensure that the voice communication will not be dropped. In one embodiment, the predetermined period of time is 500 milliseconds. Alternatively, other time periods may be selected.

Meanwhile, line card 245 within gateway module 240 continues to monitor both virtual circuits 238 and 239 to detect the arrival of data packets. If line card 245 continues to fail to receive any data packets on either virtual circuit for a predetermined period of time after transmission of the type A message, then line card 245 retransmits another type A message along both virtual circuits 238 and 239. In one embodiment, the predetermined period of time is 250 milliseconds and is selected to avoid a flood of messages reaching line card 225 and prompting it to switch the connection continuously between

virtual circuits 228 and 229. Alternatively, another period of time may be selected to accomplish the same objective.

In one embodiment, line card 225 within gateway module 220 decides to end the connection and stop transmission of data packets. Line card 245 within gateway module 240 will detect the delay in receipt of data packets, but will not know whether the delay reflects the end of the communication or a network failure. Therefore, line card 245 will transmit the message signaling the network failure at the predetermined time intervals. Line card 225 will receive the periodic messages, but will discard the messages without switching virtual circuits and establishing a new connection.

In one embodiment, line card 225 within gateway module 220 encounters a silence-induced gap in transmission of data packets, which appears as a result of a silent period during the voice communication, i.e. when the user is not communicating. As a result, although the connection is still active, line card 225 has no data packets to transmit for a period of time. Line card 245 within gateway module 240 will detect the gap in receipt of data packets, but will not know whether the gap reflects the silence-induced gap or a network failure and will transmit the message signaling the network failure at the predetermined time intervals. While line card 225 within gateway module 220 still detects the gap, it will receive and discard the messages without switching virtual circuits.

Alternatively, when line card 225 initially encounters the gap, it may send a type B message to line card 245 signaling appearance of a gap in transmission of data. When line card 245 receives the type B message signaling the gap, it will not start the 50 milliseconds timer and will not send a message during the gap in transmission.

Figure 4 is a flow diagram representing the method for improving reliability of a packet network as applied to a transmitting gateway module. As shown in the flow diagram of **Figure 4**, at processing block 410, line card 225 within gateway module 220 transmits data packets on a first virtual circuit 228 along an established connection. At processing block 420, line card 225 receives a message signaling a failure in the network on a second virtual circuit 229. At processing block 430, line card 225 checks whether the transmission of data is complete and the connection has become inactive.

If transmission is complete, line card 225 discards the message at processing block 440. Otherwise, if data still needs to be transmitted, line card 225 verifies whether a silent period has occurred and whether the delay is temporary at processing block 450.

If a silent period has occurred, line card 225 discards the message at processing block 460. Otherwise, at processing block 470, line card 225 switches transmission of data to virtual circuit 229.

Figure 5a is a flow diagram representing the method for improving reliability of a packet network as applied to a receiving gateway module. As shown in the flow diagram of **Figure 5a**, at step 510, receiving line card 245 within gateway module 240 receives data on a first virtual circuit 238 along an established connection.

A timer is then set for 50 milliseconds, step 520. Then, the process determines whether the timer expires before data is received, step 530. If data is received before the timer expires, step 520 is repeated and the timer is reset for another 50 milliseconds. If the timer expires before data is received, then a type A message is transmitted on first and second virtual circuits, step 540. A type A message indicates that no data has been received for a certain period of time. A timer is then set to 250 milliseconds, step 550. The process then determines whether the timer expires before data is received, step 560. If not, then the process continues at step 520. If the timer does expire before receiving data, then the process continues at step 540.

Figure 5b shows an alternative embodiment of a method for improving reliability of a packet network as applied to a receiving gateway module. As shown in the flow diagram of **Figure 5b**, at step 510, receiving line card 245 within gateway module 240 receives data on a first virtual circuit 238 along an established connection.

A timer is then set for 50 milliseconds, step 520. Then, the process determines whether the timer expires before data is received, step 530. If data is received before the timer expires, the process determines whether a type B message is received, step 535. A type B message indicates the beginning of a silent period. If the type B message has not been received, then step 520 is repeated and the timer is reset for another 50 milliseconds. If a type B message is received, then the process continues at step 510 and data is received on the first virtual circuit.

If the timer expires before data is received, then a type A message is transmitted on first and second virtual circuits, step 540. A timer is then set to 250 milliseconds, step 550. The process then determines whether the timer expires before data is received, step 560. If not, then the process continues at step 520. If the timer does expire before receiving data, then the process continues at step 540.

In addition to operating as described, the roles of the transmitting line card 225 within gateway module 220 and the receiving line card 245 within gateway module 240 may also be reversed to allow for the transmission of data in both directions between the end users, 210 and 250.

Asynchronous Transfer Mode (ATM) Network Implementation

Figure 6 shows an alternate embodiment of the system for improving reliability in an Asynchronous Transfer Mode (ATM) network. As illustrated in

Figure 6, if network 200 is an ATM network, data transport relies on end-to-end virtual circuits. End-to-end virtual circuits connect line cards within respective gateway modules and avoid a connection to a router within the network. In one embodiment, the virtual circuits are Switched Virtual Circuits (SVCs).

Referring to **Figure 6**, each voice connection established between line card 225 within gateway module 220 and line card 245 within gateway module 240 requires two SVCs 270 and 280 to be established. Each of the two SVCs 270 and 280 uses a different routing to accommodate the connection. Line card 225 uses one SVC, for example, in one embodiment, SVC 270, to transmit and receive data to and from line card 245. In this embodiment, SVC 280 is a standby virtual circuit and is not used for transmission of data until a failure is detected and declared within network 200. Line cards 225 and 245 are initially provisioned to only monitor SVC 270 for receipt of data packets.

When a failure is detected within network 200, and the failure affects SVC 270, the flow of data packets along SVC 270 stops and line cards 225 and 245 stop receiving data. Assuming the network failure is closer to line card 245 than line card 225, line card 245 is the first one to detect the gap of a predetermined duration in receipt of data packets and sends a type A message signaling the gap to line card 225 along both SVCs 270 and 280. In one embodiment, the predetermined period of time is 50 milliseconds. At the same time, line card 245 switches to SVC 280 and monitors SVC 280 for arrival of

data. However, line card 245 continues to transmit data packets to line card 225 along SVC 270.

Line card 225 also detects a gap of a predetermined duration in receipt of data from line card 245 and subsequently sends a similar type A message signaling the gap to line card 245 along both SVCs 270 and 280. At the same time, line card 225 switches to SVC 280 in order to monitor SVC 280 for arrival of data, while continuing to send data along SVC 270.

Next, line card 225 receives the message sent by line card 245 and starts transmission of data packets along SVC 280. Subsequently, line card 245 receives the message sent by line card 225 and starts transmission of data packets along SVC 280. Therefore, the connection established between line cards 225 and 245 is switched to the standby SVC 280 and a drop is avoided.

In the foregoing specification, the invention has been described with reference to specific exemplary embodiments thereof. It will, however, be evident that various modifications and changes may be made thereto without departing from the broader spirit and scope of the invention as set forth in the appended claims. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.

CLAIMS

What is claimed is:

1. A method comprising:

transmitting data on a first virtual circuit in a network;

receiving a message on a second virtual circuit in said network, said message signaling a failure detected in said network; and

switching said data transmitted on said first virtual circuit to said second virtual circuit within a predetermined period of time.

2. The method according to claim 1, wherein said network is an Internet Protocol (IP) network.

3. The method according to claim 1, wherein said network is an Asynchronous Transfer Mode (ATM) network.

4. The method according to claim 1, wherein receiving said message further comprises monitoring said first virtual circuit and said second virtual circuit.

5. The method according to claim 1, wherein said data is transmitted along one connection of a plurality of connections established in said first virtual circuit.

6. The method according to claim 5, wherein a predetermined bandwidth to support said plurality of connections is assigned to said first virtual circuit and said second virtual circuit.

7. The method according to claim 1, wherein said predetermined period of time is 500 milliseconds.

8. The method according to claim 5, wherein switching said data further comprises transmitting said data related to said one connection on said second virtual circuit.

9. The method according to claim 5, wherein switching said data is performed for said one connection of said plurality of connections in said first virtual circuit.

10. The method according to claim 5, wherein receiving said message further comprises:

detecting a predetermined gap in transmission of said data along said one connection; and

discarding said message without switching said data.

11. The method according to claim 5, wherein receiving said message further comprises:

detecting a predetermined gap in transmission of said data along said one connection;

transmitting a data packet signaling said predetermined gap; and

discarding said message without switching said data.

12. The method according to claim 5, wherein switching said data further comprises:

canceling transmission of said data along said one connection in said first virtual circuit;

establishing a second connection in said second virtual circuit; and

transmitting said data along said second connection in said second virtual circuit.

13. The method according to claim 5, wherein receiving said message further comprises:

completing transmission of said data along said one connection; and

discarding said message without switching said data.

14. The method according to claim 5, wherein said one connection is a Voice over Internet Protocol (VoIP) connection.

15. The method according to claim 5, wherein said one connection is a Voice over Asynchronous Transfer Mode (VoATM) connection.

16. A method comprising:

receiving data on a first virtual circuit in a network;

transmitting a message on a second virtual circuit and said first virtual circuit in said network, if said data is not received for a predetermined period of time; and

receiving said data on said second virtual circuit in said network.

17. The method according to claim 16, wherein said network is an Internet Protocol (IP) network.

18. The method according to claim 16, wherein said network is an Asynchronous Transfer Mode (ATM) network.

19. The method according to claim 16, further comprising:

monitoring said first virtual circuit and said second virtual circuit for a second predetermined period of time; and

transmitting said message if said data in not received during said second predetermined period of time.

20. The method according to claim 16, wherein said predetermined period of time is 50 milliseconds.

21. The method according to claim 19, wherein said second predetermined period of time is 500 milliseconds.

22. The method according to claim 16, further comprising monitoring said first virtual circuit and said second virtual circuit for said predetermined period of time.

23. The method according to claim 16, wherein a plurality of connections is established on said first virtual circuit.

24. The method according to claim 16, wherein said data is received along one connection of a plurality of connections established in said first virtual circuit.

25. The method according to claim 24, wherein transmitting said message further comprises monitoring said connection for said predetermined period of time.

26. The method according to claim 24, wherein transmitting said message further comprises detecting a failure on said one connection in said first virtual circuit.

27. The method according to claim 26, wherein said detecting is performed subsequent to receiving a first data packet of said data along said one connection.

28. The method according to claim 22, wherein said monitoring is performed subsequent to receiving a first data packet of said data on said first virtual circuit.

29. The method according to claim 23, wherein a predetermined bandwidth to support said plurality of connections is assigned to said first virtual circuit and said second virtual circuit.

30. The method according to claim 24, wherein said one connection is a Voice over Internet Protocol (VoIP) connection.

31. The method according to claim 24, wherein said one connection is a Voice over Asynchronous Transfer Mode (VoATM) connection.

32. An apparatus comprising:

means for transmitting data on a first virtual circuit in a network;

means for receiving a message on a second virtual circuit in said network, said message signaling a failure detected in said network; and

means for switching said data transmitted on said first virtual circuit to said second virtual circuit within a predetermined period of time.

33. The apparatus according to claim 32, wherein said means for receiving further comprises means for monitoring said first virtual circuit and said second virtual circuit.

34. An apparatus comprising:

means for receiving data on a first virtual circuit in a network;

means for transmitting a message on a second virtual circuit and said first virtual circuit in said network, if said data is not received for a predetermined period of time; and

means for receiving said data on said second virtual circuit in said network.

35. The apparatus according to claim 34, further comprising:

means for monitoring said first virtual circuit and said second virtual circuit for a second predetermined period of time; and

means for transmitting said message if said data in not received during said second predetermined period of time.

36. A computer readable medium having instructions which, when executed by a processing system, cause the system to:

transmit data on a first virtual circuit in a network;

receive a message on a second virtual circuit in said network, said message signaling a failure detected in said network; and

switch said data transmitted on said first virtual circuit to said second virtual circuit within a predetermined period of time.

37. The medium of claim 36, wherein the executed instructions further cause the system to:

receive said message by monitoring said first virtual circuit and said second virtual circuit.

38. A computer readable medium having instructions which, when executed by a processing system, cause the system to:

receive data on a first virtual circuit in a network;

transmit a message on a second virtual circuit and said first virtual circuit in said network, if said data is not received for a predetermined period of time; and

receive said data on said second virtual circuit in said network.

39. The medium of claim 38, wherein the executed instructions further cause the system to:

monitor said first virtual circuit and said second virtual circuit for a second predetermined period of time; and

transmit said message if said data in not received during said second predetermined period of time.

ABSTRACT

A system and method for improving reliability of a packet network are described. Data is transmitted on a first virtual circuit in the network. A message signaling a failure in receipt of the data is received on a second virtual circuit in the network. Finally, transmission of data is switched to the second virtual circuit within a predetermined period of time.

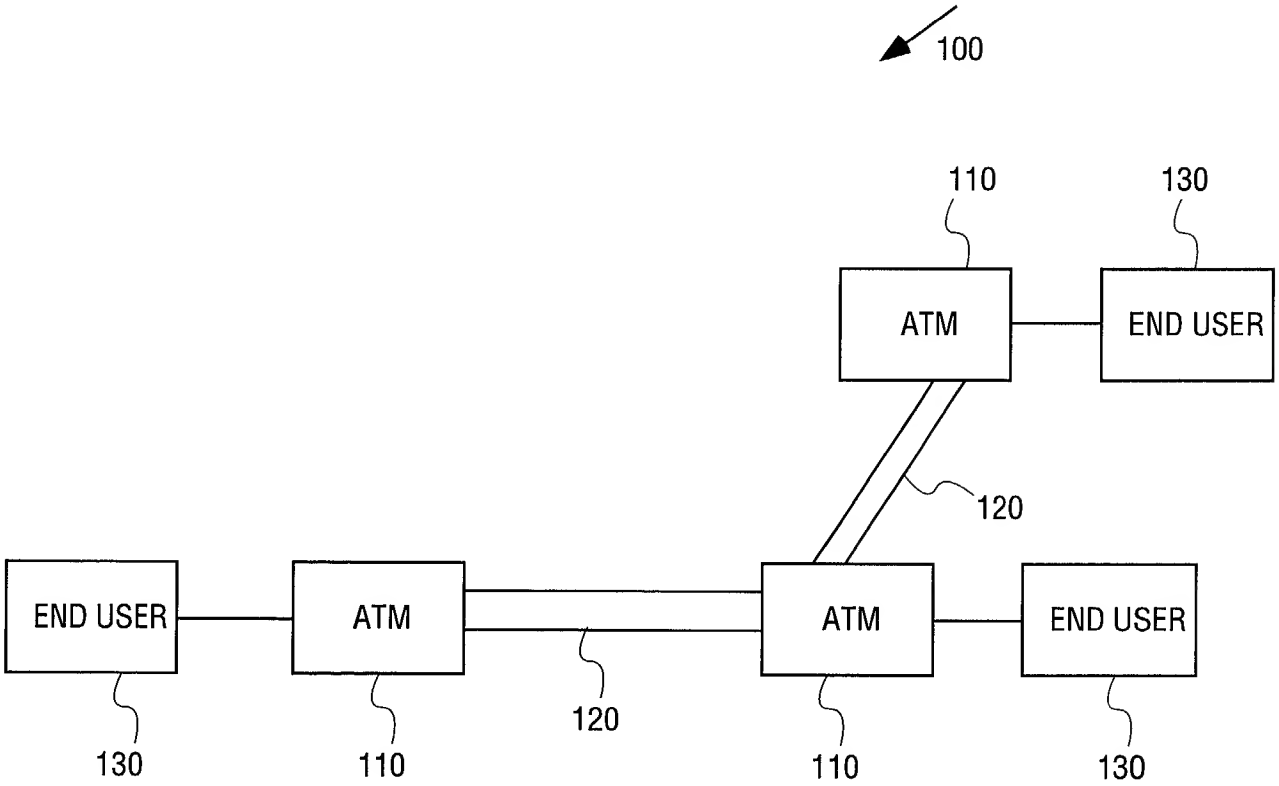

FIG. 1A

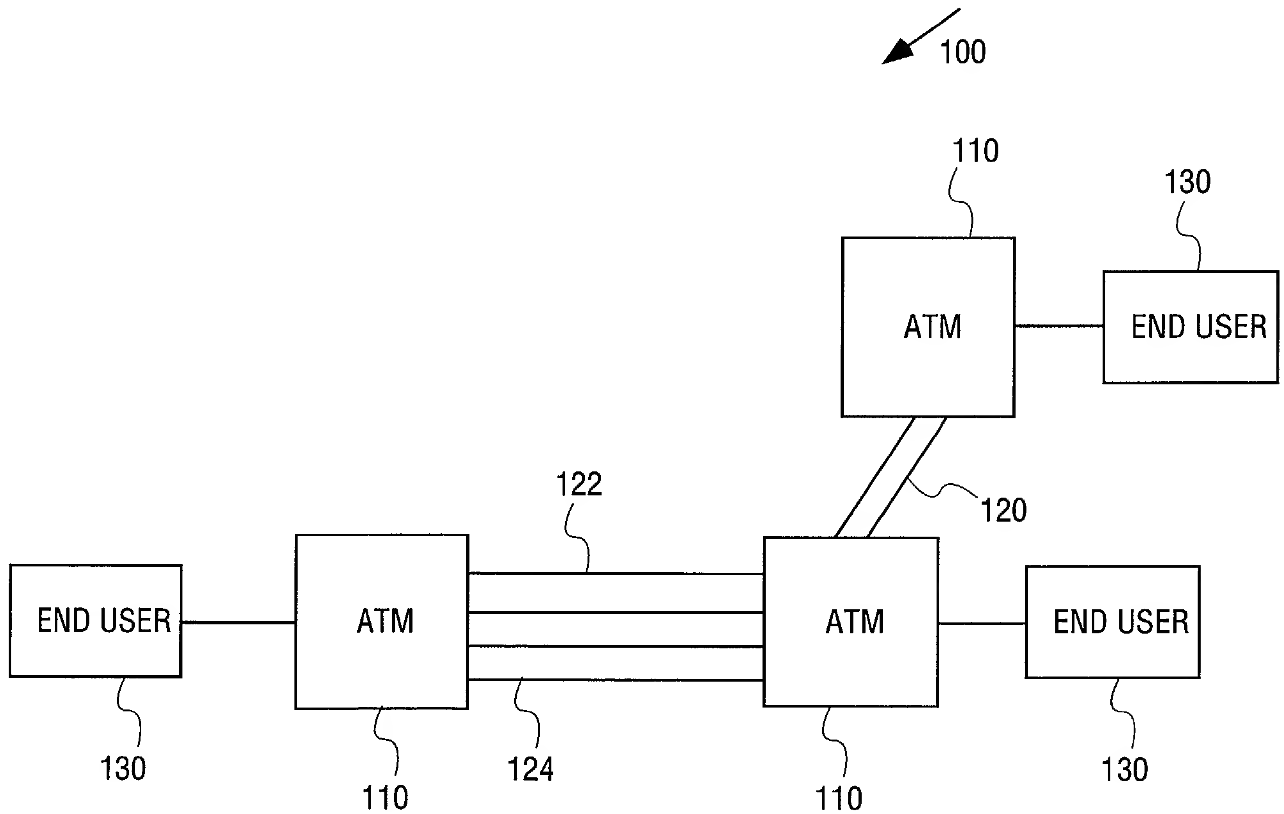
100
110
130
ATM
END USER
122
120
END USER
ATM
ATM
END USER
130
110
124
110
130

FIG. 1B

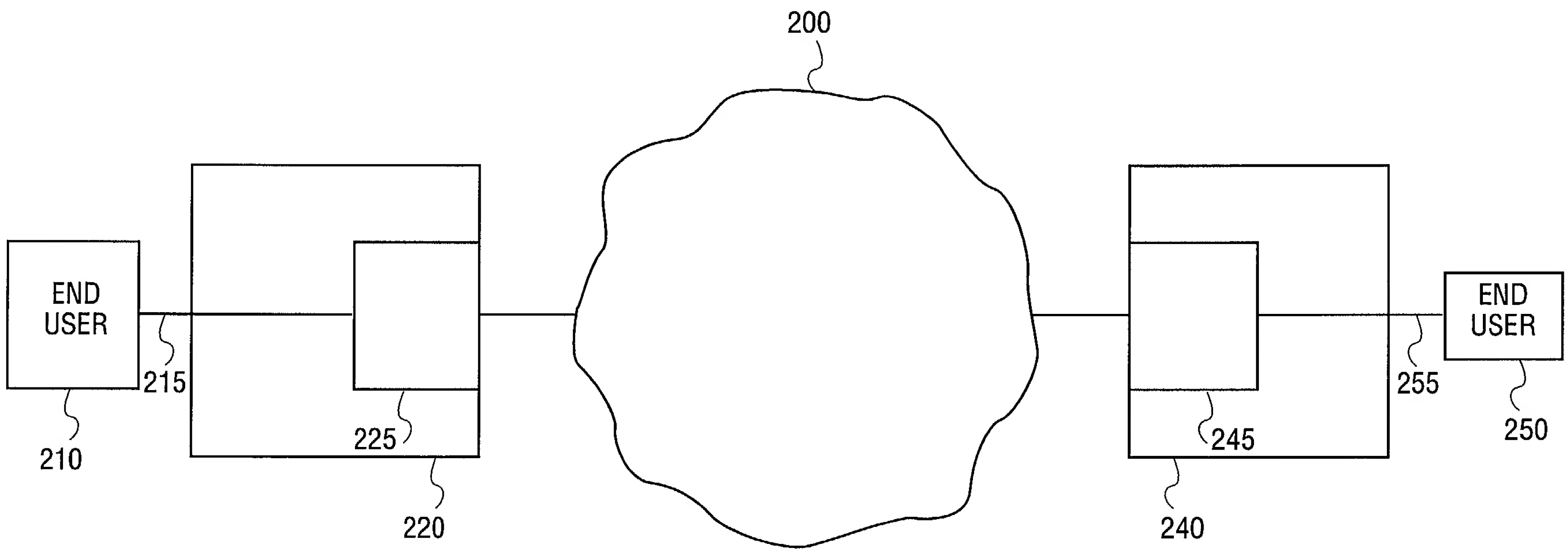

FIG. 2

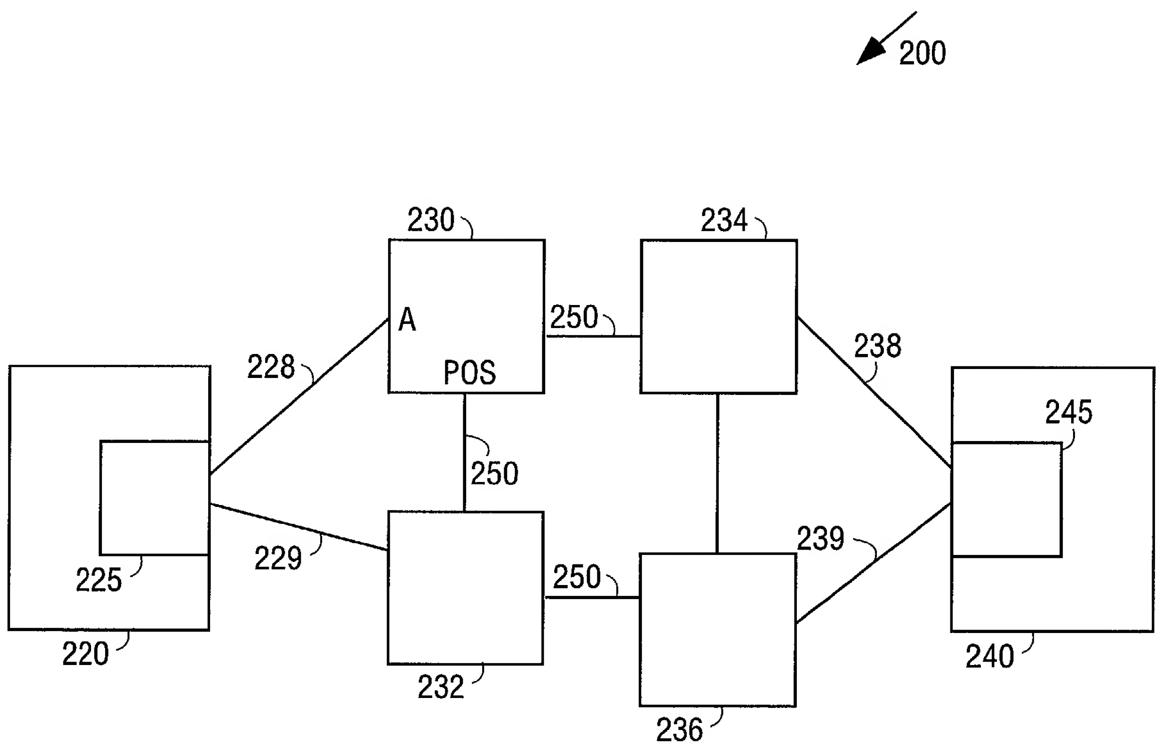

FIG. 3

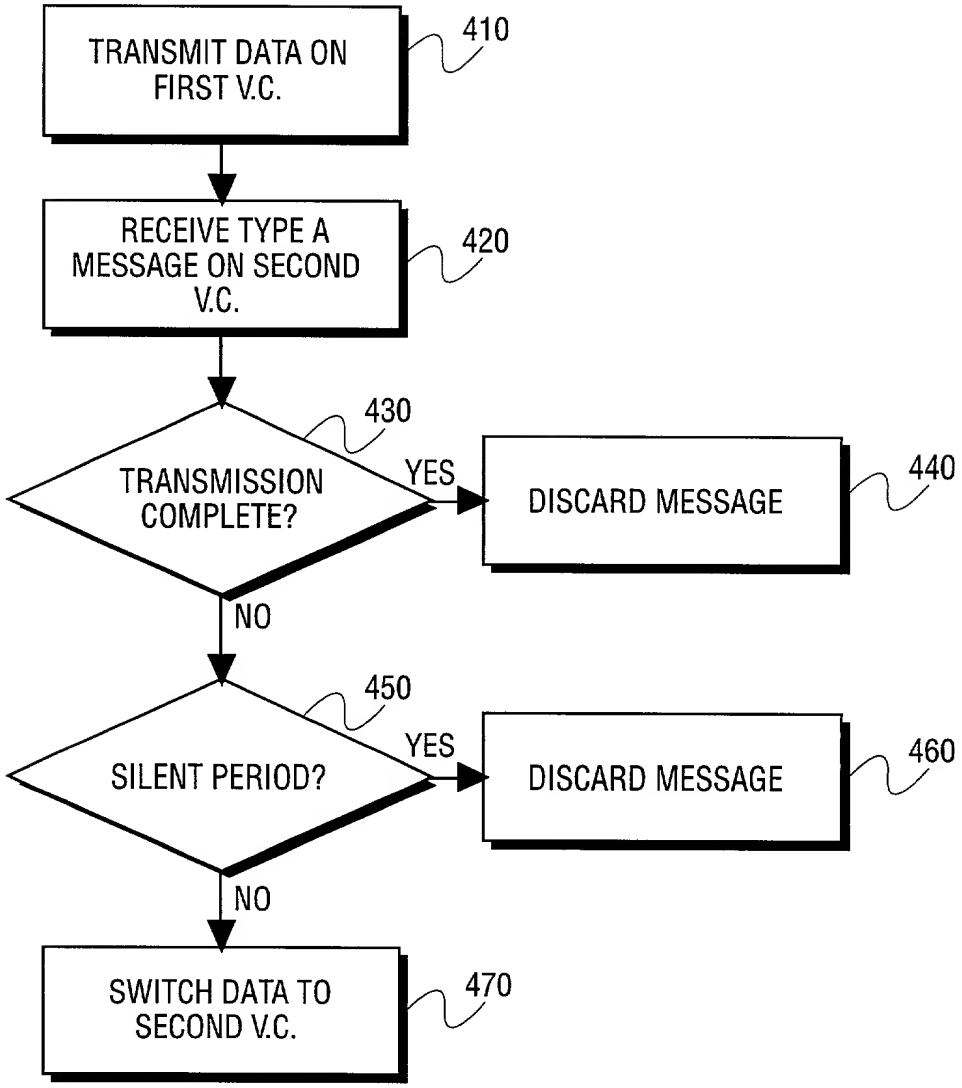
TRANSMIT DATA ON FIRST V.C.
410
RECEIVE TYPE A MESSAGE ON SECOND V.C.
420
TRANSMISSION COMPLETE?
430
YES
DISCARD MESSAGE
440
NO
SILENT PERIOD?
450
YES
DISCARD MESSAGE
460
NO
SWITCH DATA TO SECOND V.C.
470

FIG. 4

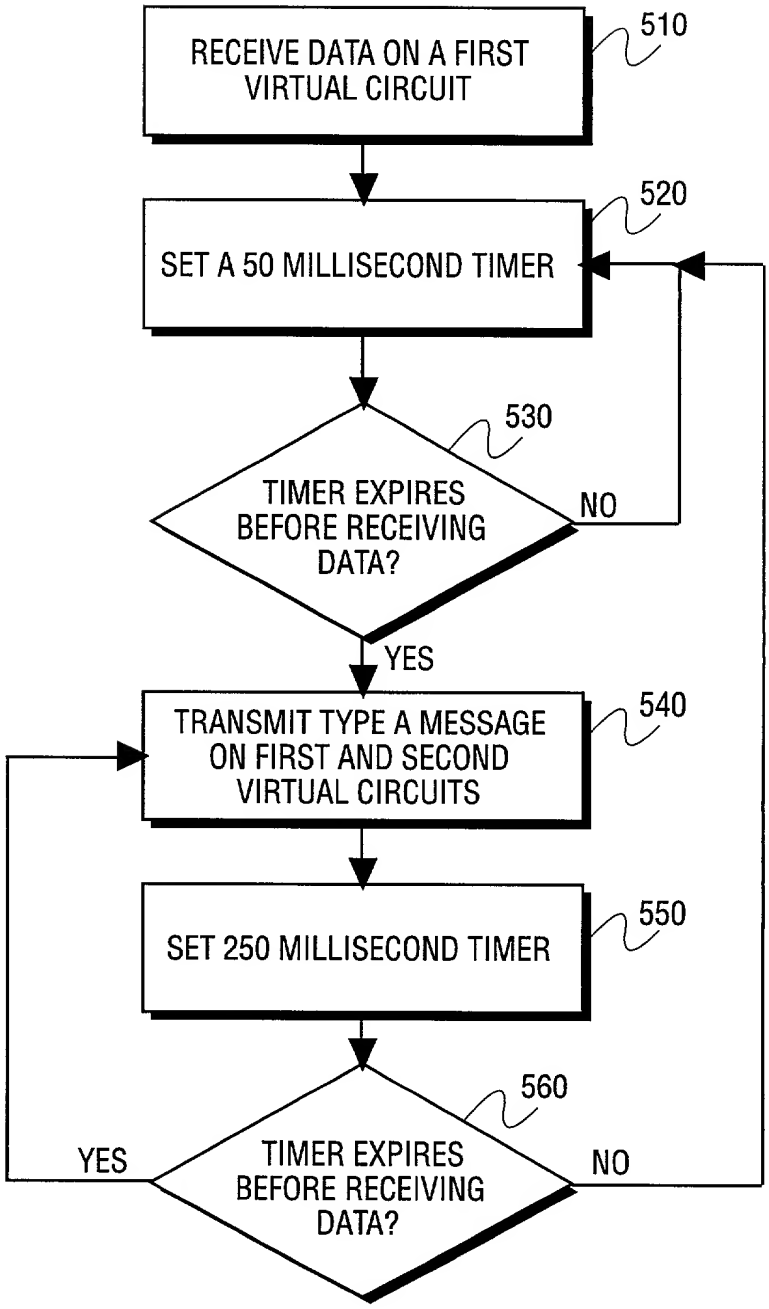
RECEIVE DATA ON A FIRST VIRTUAL CIRCUIT
510
SET A 50 MILLISECOND TIMER
520
TIMER EXPIRES BEFORE RECEIVING DATA?
530
NO
YES
TRANSMIT TYPE A MESSAGE ON FIRST AND SECOND VIRTUAL CIRCUITS
540
SET 250 MILLISECOND TIMER
550
TIMER EXPIRES BEFORE RECEIVING DATA?
560
YES
NO

FIG. 5A

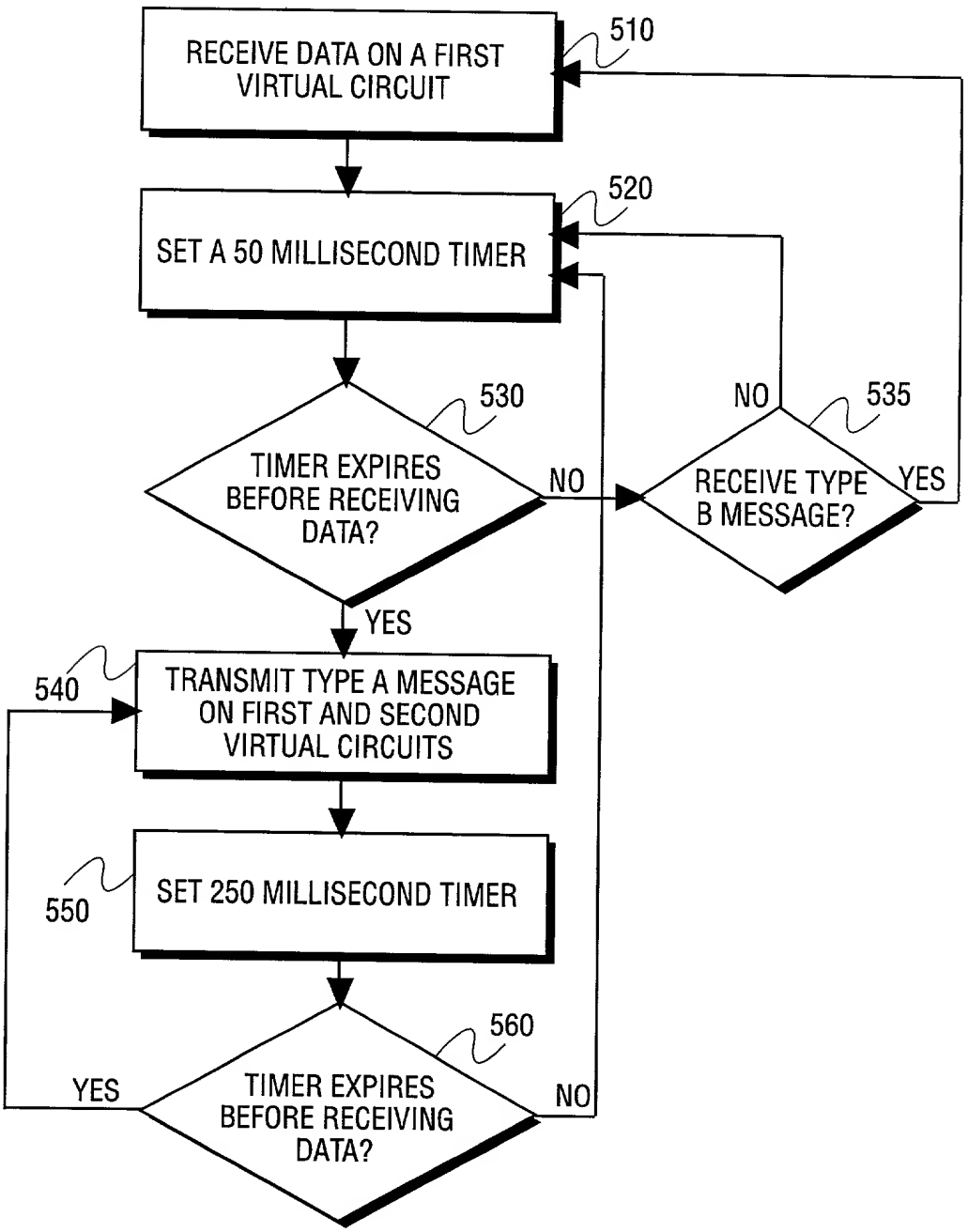
RECEIVE DATA ON A FIRST VIRTUAL CIRCUIT
510
SET A 50 MILLISECOND TIMER
520
TIMER EXPIRES BEFORE RECEIVING DATA?
530
NO
RECEIVE TYPE B MESSAGE?
535
NO
YES
YES
TRANSMIT TYPE A MESSAGE ON FIRST AND SECOND VIRTUAL CIRCUITS
540
SET 250 MILLISECOND TIMER
550
TIMER EXPIRES BEFORE RECEIVING DATA?
560
YES
NO

FIG. 5B

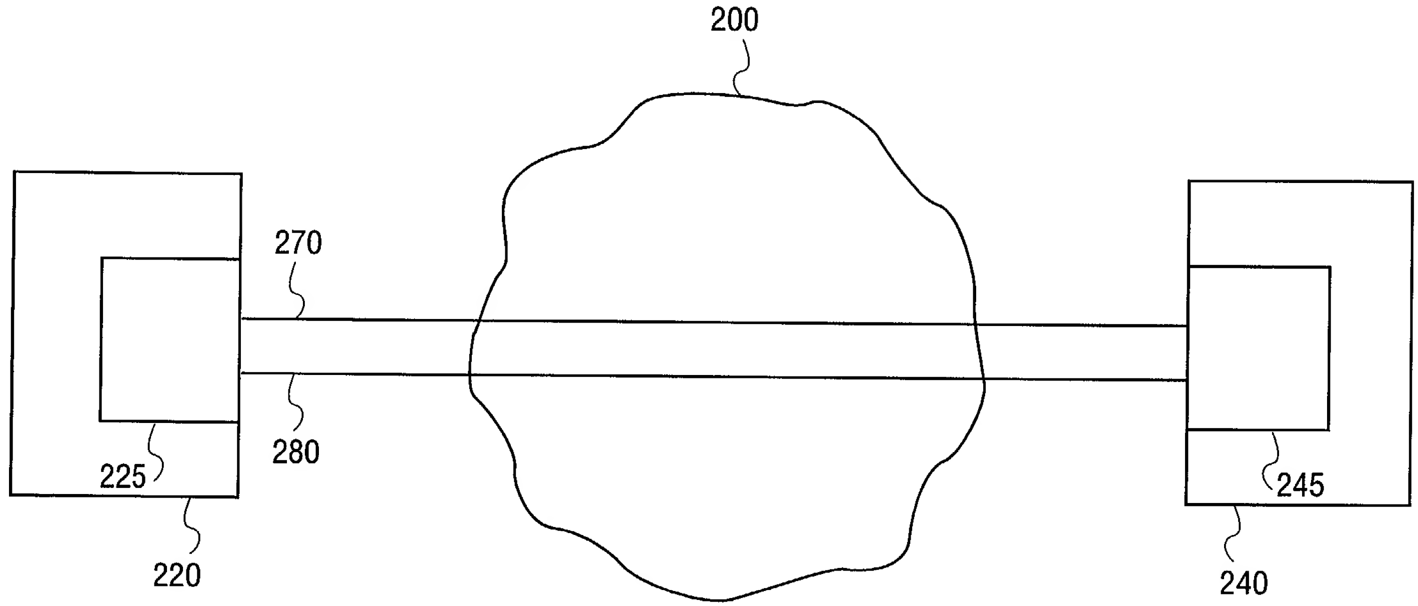

FIG. 6

Attorney's Docket No.: 81862.P168 Patent

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

SYSTEM AND METHOD FOR IMPROVING RELIABILITY OF A PACKET NETWORK

the specification of which

__X__ is attached hereto.
_____ was filed on _____ as
United States Application Number_____
or PCT International Application Number _____
and was amended on _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below:

(Application Number)	Filing Date
(Application Number)	Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Number)	Filing Date	(Status -- patented, pending, abandoned)
(Application Number)	Filing Date	(Status -- patented, pending, abandoned)

I hereby appoint the persons listed on Appendix A hereto (which is incorporated by reference and a part of this document) as my respective patent attorneys and patent agents, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send correspondence to Jeffrey S. Smith, BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP, 12400 Wilshire Boulevard 7th Floor, Los Angeles, California 90025 and direct telephone calls to Jeffrey S. Smith, (408) 720-8598.

(Name of Attorney or Agent)

(Name of Attorney or Agent)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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APPENDIX A

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APPENDIX B

Title 37, Code of Federal Regulations, Section 1.56
Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclosure information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclosure all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.